Appendix B Continued

Answers to Supplemental Problems

Chapter 1

No supplemental problems

Chapter 2

1. **a.** 8.1×10^{5} g
   b. 6.34×10^{-4} g
   c. 6×10^{7} g
   d. 1.0×10^{-6} g
2. **a.** 5.8×10^{-8} s
   b. 4.6×10^{7} s
   c. 9.27 s
   d. 1.23×10^{4} s
3. **a.** 6.32×10^{-3} s
   b. 8.36×10^{8} km
   c. 1.69×10^{4} cm^2
   d. 6.45×10^{-13} m/s
4. **a.** 4
   b. 5
   c. 3
   d. 3
5. **a.** 3
   b. 5
   c. 2
   d. 4
6. **a.** 90.0 g
   b. 1.68 km
   c. 128.6 kg
   d. 47.9 s
7. **a.** 2×10^{16} m^2
   b. 1.4×10^{-7} km^2
   c. 2.8 kg/m^3
   d. 1.7×10^{-3} m/s
8. **a.** 22.2 m
   b. 21 m^2
9. **c.** $d = 5t^2$
10. **d.** 0.30 m/s
    e. $d = 0.30t$
11. **a.** $m = \frac{Fr}{v^2}$
    b. $r = \frac{mv^2}{F}$
    c. $v = \sqrt{\frac{Fr}{m}}$
12. $d_0 = \frac{d_i f}{d_i - f}$
13. **a.** 160 cm^2
    b. 140 cm^2

Chapter 3

1. **a.** 205 m
   b. –45 m
   c. 205 m
2. 15 km/h; 0
3. 330 m/s
4. 20 m/s
5. **a.** 0.450 s
   b. 2592 km/h
6. 3.3×10^{-7} s
7. 60 km/h
8. **b.** 13.5 m, 5.5 s
9. **a.** 10 m
   b. 30 m
   c. 0 m
   d. –40 m
   e. 80 m distance, but no displacement
10. **a.** 2 m/s
    b. 6 m/s
    c. 0 m/s
    d. –8 m/s
11. **b.** 1 h
12. **a.** ≈ 10 m/s
    b. 0 m/s
    c. ≈ –10 m/s
13. **c.** 75 m/s
    e. 300 m
14. **b.** 3600 m
    c. 9000 m
    d. 0 m
15. **a.** 25 km/h
    b. 145 km/h

Chapter 4

1. -3.3×10^{3} m/s^2
2. **a.** constant velocity = 10 m/s
   b. slows to $v = 0$ m/s
   c. 0 m/s^2
   d. –5 m/s^2
3. **c.** ≈ 30 m/s^2
4. 8.00 s
5. 34 m/s
6. 160 m
7. **a.** –8.0 m/s^2
   b. 480 m
8. **a.** 4.9×10^{-3} s
   b. 3.3×10^{2} m/s
9. **a.** 2.8 m/s^2
   b. 35 m
10. 26 m/s
11. –81 m/s^2
12. 35 m/s = 130 km/h
13. **a.** 0.23 m/s
    b. 0.24 m/s^2
14. **a.** 59 m/s
    b. 1.8×10^{2} m
15. 5.6 s
16. –20 m

Chapter 5

1. 2.36×10^{3} N in direction of acceleration
2. 750 kg
3. 75 N
4. 60 kg
5. 3.3 m/s^2
6. **a.** 3.6 m/s^2
   b. 4.9×10^{2} N
7. 1.6×10^{-26} N
8. **a.** 2 N
   b. 0.02
9. 7.4 N
10. 0.60 m/s^2
11. 3.3×10^{3} N
12. **a.** 490 N
    b. 490 N
    c. 3.8×10^{2} N
    d. 3.6×10^{2} N
    e. 490 N
    f. 0
13. 3.3 m/s^2

Chapter 6

1. **a.** $\theta = 84.000°$
   b. $\theta = 27.00°$
   c. $\theta = 35.00°$
   d. $\theta = 7.998°$
   e. $\theta = 49.00°$
   f. $\theta = 12.01°$
2. **a.** 0.53
   b. 1.0
   c. 1
   d. 1.6
   e. 0.64
   f. 0.33
4. **a.** 140 N
   b. 20 N
   c. 100 N
5. 38.5 min
6. **a.** 90 N
   b. 87 N
   c. 84 N
   d. 79 N
   e. 67 N
   f. 30 N
7. R = 42 m, 315°
8. V = 112 m/s, 117°
9. F = 820 N, 232°
10. R = 48.1 m, 3.6° north of east
11. 1.93×10^{2} km, north
    2.30×10^{2} km, east
12. 200 N
13. V_x = –50.0 km/h,
    V_y = –86.6 km/h
14. **a.** horizontal = 48 N;
    vertical = 82 N
    b. horizontal = 82 N;
    vertical = 48 N
15. 0.71 m/s^2
16. **a.** 30 N
    b. 29 N
    c. 21 N
    d. 15 N
    e. 0 N
17. 580 km/h, 54° east of north
18. 74 N, 253°
19. 460 N
20. 22 N
21. **a.** 4.9 m/s^2
    b. 59 m
    c. 1 s

Chapter 7

1. **a.** 10.0 s
   b. 2.00×10^{3} m
2. 0.966 m
3. 132 m
4. 1.7 m
5. 1.7 m
6. **a.** 3.46 s
   b. 58.8 m
7. **a.** 55°
   b. 14 m
8. **a.** 28 m/s
   b. 4.1 s
   c. 20 m
9. **a.** 57.9 m
   b. 10.2 m
10. 13 m/s
11. 1.5×10^{3} m
12. **a.** 2.1×10^{2} N
    b. 1.7×10^{2} N
13. 972 N
14. 2.0 m
15. **a.** 2.01 s
    b. 4.86 s
16. **a.** 0.10 kg
    b. 0.25 m,
    c. shorten pendulum to 4.1 cm

Chapter 8

1. 2.7×10^{12} m
2. **a.** 2.21×10^{15} m^2/s
   b. 2.0×10^{11} m^2/s
3. 4.2×10^{7} m
4. 1.0×10^{-47} N
5. 6.67×10^{-11} N
6. **a.** 1.6×10^{3} kg
   b. 1.3×10^{-10} m/s^2
7. 8.3×10^{-9} N
8. 7.2×10^{22} kg
9. **a.** 1.7×10^{-10} N
   b. 1.7×10^{-12} N
10. 6.0×10^{24} kg
11. 235 N
12. 79 days
13. $V = 3.47 \times 10^{3}$ m/s;
    $T = 6.45 \times 10^{3}$ s or 1.79 h
14. 19.6 m/s^2; 2.45 m/s^2; 4.9 m/s^2
15. 7.35 m/s^2
16. 1.60 m/s^2

Chapter 9

1. 0.013 s
2. **a.** 74 N · s
   b. 1.0×10^{1} m/s
3. **a.** 2.0×10^{4} kg · m/s
   b. 1.3×10^{3} N
4. -1.2×10^{3} N
5. -6.0×10^{1} N
6. **a.** –14.5 kg · m/s
   b. -3.2×10^{4} N
7. **a.** 1.32×10^{4} kg · m/s
   b. -1.32×10^{4} kg · m/s
   c. 1.32×10^{4} kg · m/s
   d. –19.4 m/s
8. 9.6 km/h
9. –4.94 m/s
10. 0.30 m/s
11. 0.35 m/s
12. 1.1 m/s
13. 1.26 in direction of riding
14. 2.8 m/s
15. **b.** 3.5 m/s; 67°

Chapter 10

1. 988 J
2. 2.75×10^4 N
3. 8.87×10^7 J
4. 3.44×10^3 J
5. 4.4×10^3 J
6. 3.4×10^3 J
7. 8.0×10^4 J
8. 36.2°
9. 3.4×10^4 W
10. 126 W
11. 2.04×10^3 W
12. 0.63 kW
13. **a.** 3.5
    b. 4.00
    c. 88%
14. 0.24 m
15. 31.5 cm

Chapter 11

1. 2.26×10^{-12} J
2. 0.90 J
3. **a.** 84 J
   b. 84 J
   c. 11 m/s
4. 5.2 m
5. **a.** 2.6×10^4 J
   b. 66 m
   c. 3.9×10^2 N
6. 2.1 J
7. 2.8×10^3 J
8. –2.0 J
9. 0.24 m
10. 72°
11. **a.** 1.17×10^3 J
    b. 3.00×10^3 J
    c. 3.00×10^3 J
    d. 4.17×10^3 J
    e. 23.6 m/s
12. **a.** 2.4×10^5 J
    b. 2.0×10^2 m
    c. 1.2×10^3 N
    d. 1.7×10^3 N
13. **a.** 12.5 m/s
    b. 781 J
14. 19 m/s
15. 2.8×10^2 m/s

Chapter 12

1. 238.55 K
2. –222.87°C
3. 1.3×10^5 J removed
4. 3.94×10^3 J
5. 4.6 kg
6. 0°C
7. 132 J/kg · K
8. **a.** 8.2×10^3 J
   b. 1.3×10^2 J/kg · K
9. 25.2°C
10. $T_f = 16.2$°C
11. 1.18×10^5 J
12. 3.6×10^5 J
13. 30.0°C
14. 0.29°C
15. 47.8 g

Chapter 13

1. 0.760 m
2. 1.6×10^4 Pa
3. 36.5 kg
4. 4.0×10^3 Pa
5. **a.** 1.61×10^3 Pa
   b. 6.07×10^3 Pa
6. **a.** 412 N
   b. 4.20×10^{-2} m^3
7. 16.0
8. 875 N
9. 5.00×10^3 kg/m^3
10. 3.92×10^6 N
11. -2.7×10^{-1} m
12. 0.801 m^3
13. 5.3×10^3 cm^3
14. 4.5×10^{-2} cm
15. 719°C

Chapter 14

1. 5.00 m
2. **a.** 0.250 s
   b. 4.00 Hz
3. **a.** 0.244 s
   b. 4.10 Hz
4. 1.50 m/s
5. 0.330 m/s
6. 0.600 m/s
7. 8.00 m/s
8. 1.6 m
9. 3.00 m
10. 12.0 Hz
11. 24°

Chapter 15

1. 8.6×10^2 m
2. 150 m/s
3. 800 m/s
4. 1.60 m
5. 0.635 m
6. 1.07 s
7. 7.87 s
8. 1030 m
9. 430 Hz
10. 310 Hz
11. 70 dB
12. 110 dB
13. 451 Hz
15. 4 Hz
16. 8 beats/s
17. 435 Hz

Chapter 16

1. 4.5×10^2 nm
2. 4.50×10^5 m
3. 3.8×10^{16} m

4. 2.7×10^2 s
5. 2.5 s
6. 3.37×10^{-7} s
7. 364 m
8. 60 MHz
9. 0.50 lx
10. 1.1×10^2 cd
11. 6.9 m

Chapter 17

1. 28°
2. 1.37
3. 15.9°
4. 48.4°
5. 85.23560°
7. 49.5°
8. apparent interception of rays at 9.0 cm below surface; apparent depth/ true depth = 0.75
9. 2.26×10^8 m/s
10. 1.28×10^8 m/s
11. 1.71
13. 1.56
14. 29.8°
17. 0.20
18. 2.0×10^6 m/s

Chapter 18

1. 75 cm behind mirror
2. 20.0 cm
3. 75.0 cm
4. 6.25 cm in front of mirror
5. 24.2 cm
6. 42.6 cm
7. **a.** 21.1 cm
   b. –3.81 cm; inverted
8. –1.92 cm; inverted
9. 3.0
10. –0.15 m
11. –0.060 m
12. 39.3 cm
13. 10 cm
14. 1.1×10^2 cm
15. –1.5 cm; inverted
16. 6.7 cm
17. 0.19 mm
18. 15 cm
19. 25 cm; erect

Chapter 19

1. 4.00×10^2 nm
2. 5.0×10^2 nm
3. 5.40 mm
4. 0.750 m
5. 6.00 km
6. 1.3×10^{-6} m
7. 1.62 m
8. 3.7 m
9. 5.7°
10. 2.35×10^{-3} mm/line
11. 16.7°
12. 524 nm
13. 0.360 m
14. 2.18×10^{-5} m

Chapter 20

1. *F*/4
2. 4*F*
3. 1.0×10^{-5} N
4. 8.0×10^{-5} N
5. 6.25×10^{18} electrons
6. $+9.0 \times 10^3$ N
7. -1.1×10^2 N; the force is attractive
8. +44N; away
9. -9.2×10^{-16} N
10. +2.5 N
11. $\pm 2.0 + 10^{-10}$ C
12. -9.7×10^{-6} C
13. 7.4 N to the left
14. 6.7 N at 7.2° to the left of vertical

Chapter 21

1. 1.00×10^3 N/C
2. 8.0 N/C
3. 6.9 N/C
4. 1.5 mC
5. -1.60×10^{-16} N
7. 2.00×10^3 V
8. 0.15 mJ
9. 9.00×10^{10} J
10. 11 V
11. 6.0×10^3 V
12. 1.8×10^8 V/m
13. 1.2×10^{-13} N
14. 40 μF
15. 8.6×10^5 V
16. 3.6 mC

Chapter 22

1. 0.160 A
2. 1.00×10^2 C
3. 180 W
4. 83 W
5. **a.** 2.0 A
   b. 12 kJ
6. 4.00 Ω
7. 20.0 Ω
8. 0.400 V
9. **a.** 10.4 A
10. **a.** 0.500 A
    b. 0.522 A
11. 460 Ω
12. 133 Ω
13. **a.** 1.41 A
    b. 0.447 A
14. 24 W

15. 62 cents/year

16. **a.** 16.7 A
b. 7.19 Ω
c. $3.36

Chapter 23

1. **a.** 350 Ω
b. 0.143 A
c. 17.9 V

2. **b.** 60 Ω
c. 0.20 A

3. **a.** 680 Ω
b. 18 mA
c. 2.2 V

4. **a.** 0.10 A
b. 400 Ω
c. 40 Ω

5. 153 Ω

6. 7.2 Ω

7. 4.0 Ω

8. **a.** 36 Ω
b. 0.19 A
c. 0.14 A

9. **a.** 17 Ω
b. $I_1 = 1.0$ A; $I_2 = 0.64$ A; $I_3 = 0.41$ A

11. **b.** 6.0 Ω
c. 1.0 A
d. 0.75 A
e. 2.3 V

12. **b.** 20.0Ω
c. 6.00 A
d. 3.00 A
e. 90.0 V

15. **a.** 6.0×10^3 Ω
b. 6×10^3 Ω
c. 1.8×10^4 Ω
d. 2.0×10^3 Ω

Chapter 24

6. 0.11 N

7. 0.060 N

8. 21 mN

9. 0.30 T

10. 4.2 A

11. 599 kΩ

14. 9.6×10^{-16} N into the page

15. 2.8×10^{-14} N

16. 1.9×10^{-12} N

Chapter 25

2. 0.20 mV

3. 5.0 mT

4. 20 m/s

5. 10 m/s

6. **a.** 6.4 V
b. 1.0 A

7. 41 mA

8. 170 V

9. 3.5 A

10. 406 V

11. 15.0 A

12. 69.4 Ω

14. 1 to 545

15. **a.** 50 turns
b. 0.40 A

Chapter 26

1. 7.6×10^5 m/s

2. 0.47 mT

4. 2.3 mT

5. 0.27 m

6. 2.8 cm

7. 1.25×10^7 C/kg

8. 2.7×10^{-26} kg

9. 16 u

10. 2.89 cm

11. 6.25 cm

12. 0.75 cm

13. 0.794 m

Chapter 27

2. 8.21×10^{14} Hz

3. 3.8 eV

4. 1.2×10^{-18} J

5. 5.0 V

6. 5.3×10^{-19} J

7. 5.3×10^{-19} J

8. 1.07×10^{-19} J

9. 1.66×10^{-27} kg · m/s

10. 9.47×10^{-28} kg · m/s

11. 0.24 nm

12. 2.4×10^6 m/s

13. **a.** 4.2×10^7 m/s
b. 0.017 nm

Chapter 28

1. 5.38×10^{14} Hz

2. E_3

3. 2.23 eV

4. 1.15 eV

5. 0.848 nm

6. $E_1 = -0.278$ eV
$E_2 = -3.40$ eV

7. 3.12 eV

8. 7.53×10^{14} Hz

Chapter 29

1. 1.55 eV

2. 4.63×10^{22} e^-/cm^3

3. 3.1 V

4. 20 Ω

5. 0

Chapter 30

1. 47 electrons, 47 protons, 62 neutrons

2. $^{40}_{20}Ca$

3. $^{64}_{30}Zn$

4. $^{210}_{84}Bi \rightarrow {}^{4}_{2}He + {}^{206}_{82}Pb$

5. $^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{14}_{7}N + {}^{0}_{0}\bar{\nu}$

6. $^{225}_{89}Ac \rightarrow {}^{4}_{2}He + {}^{221}_{87}Fr$

7. $^{227}_{88}Ra \rightarrow {}^{0}_{-1}e + {}^{227}_{89}Ac$

8. $^{65}_{29}Cu + {}^{1}_{0}n \rightarrow {}^{66}_{29}Cu \rightarrow {}^{1}_{1}p + {}^{65}_{28}Ni$

9. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{96}_{40}Zr + 3({}^{1}_{0}n) + {}^{137}_{52}Te$

10. **a.** 25% is left
b. 12.5 % is left
c. 6.3 % is left

11. 1/16 is left

12. 5 half-lives, or 515 years

13. $^{0}_{1}e + {}^{17}_{8}O + {}^{0}_{0}\nu$

14. $^{0}_{1}e + {}^{23}_{10}Ne + {}^{0}_{0}\nu$

15. +1

16. **a.** 0
b. −1

Chapter 31

1. **a.** 0.098 940 u
b. 92.16 MeV

2. **a.** 0.291 77 u
b. 271.8 MeV

3. **a.** 0.186 96 u
b. 174.2 MeV
c. 7.916 MeV/nucleon

4. 7.01600 U

5. $^{132}_{55}Cs \rightarrow {}^{0}_{1}e + {}^{132}_{54}Xe + {}^{0}_{0}\nu$

6. $^{15}_{7}N \rightarrow {}^{1}_{1}p + {}^{14}_{6}C$

7. $^{66}_{29}Cu \rightarrow {}^{1}_{1}p + {}^{65}_{28}Ni$

8. $^{24}_{12}Mg + {}^{1}_{0}n \rightarrow {}^{25}_{12}Mg \rightarrow {}^{1}_{1}p + {}^{24}_{11}Na$

9. $^{17}_{8}O + {}^{1}_{0}n \rightarrow {}^{18}_{8}O \rightarrow {}^{4}_{2}He + {}^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{14}_{7}N + {}^{0}_{0}\bar{\nu}$

10. $^{137}_{52}Te + 3({}^{1}_{0}n) + {}^{100}_{42}Mo$

11. $^{134}_{55}Cs + 2({}^{1}_{0}n) + {}^{98}_{37}Rb$

12. $^{90}_{38}Sr + 10({}^{1}_{0}n) + {}^{136}_{54}Xe$

13. **a.** 0.15096
b. 140.6 MeV

14. $^{1}_{1}p + {}^{1}_{0}n \rightarrow {}^{2}_{1}H$ 2.224 MeV

15. **a.** $^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{1}H + {}^{1}_{1}H$
b. $^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}H + {}^{1}_{0}n$
c. $^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}H + {}^{1}_{0}n$
d. $^{3}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}H_2 + 2({}^{1}_{0}n)$